

**Missouri Department of Natural Resources  
Water Protection Program**

**Total Maximum Daily Loads (TMDLs)  
for  
Chlordane and Polychlorinated Biphenyls  
in the  
Missouri River**

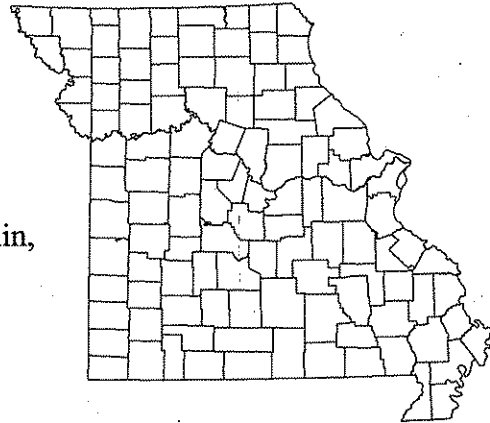
**Completed: October 5, 2006  
Approved:**

**Total Maximum Daily Loads (TMDLs)  
For the Missouri River  
Pollutants: Chlordane and Polychlorinated Biphenyls (PCBs) in Fish Tissue**

**Name:** Missouri River

**Location:** Across 25 counties: Atchison, Holt, Andrew, Buchanan, Platte, Clay, Jackson, Ray, Lafayette, Carroll, Saline, Chariton, Howard, Cooper, Moniteau, Boone, Cole, Callaway, Osage, Montgomery, Gasconade, Warren, Franklin, St. Charles and St. Louis

**Hydrologic Unit Codes (HUC):** 10240001, 10240005, 10240011, 10300101, 10300102, 10300200



**Water Body Identification Numbers (WBID):** (from the mouth at St. Louis to the Iowa border) 1604 (100 miles), 701 (129 miles), 356 (125 miles) and 226 (179 miles)

**Missouri Stream Classification:** The Missouri River is classified in the Missouri Water Quality Standards (WQS) as a Class P<sup>1</sup> stream

**Beneficial Uses for Missouri River<sup>2</sup>:**

- Livestock and Wildlife Watering
- Protection of Aquatic Life and Human Health – Fish Consumption
- Whole Body Contact Recreation, Category B
- Secondary Contact Recreation
- Irrigation
- Drinking Water Supply
- Industrial

**Pollutant:** Chlordane and PCBs in fish tissue

**Size of Impaired Segment:** 533 miles

**Pollutant Source:** Many point and nonpoint sources

**TMDL Priority Ranking:** High

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<sup>1</sup> Class P streams maintain permanent flow even in drought periods

<sup>2</sup> For beneficial uses see 10 CSR 20-7.0310(C) and Table (H)

## 1. Introduction

### 1.1 Study Area Description:

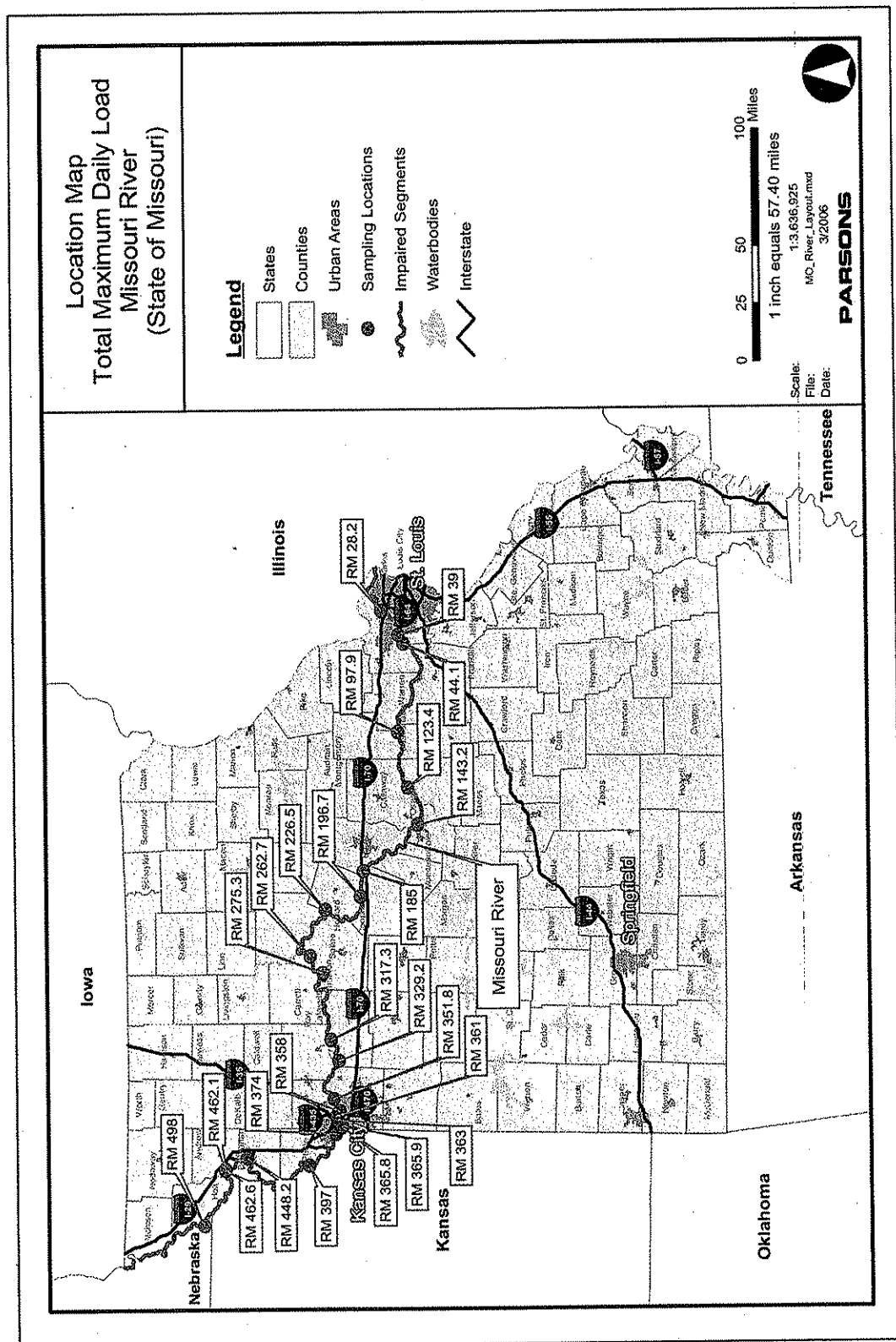
The Missouri River is 2,565 mile long starting at its headwaters in the Jefferson, Madison and Gallatin Rivers, which converge near Three Forks, Montana, to form the Missouri River. The river flows north through mountainous canyons before emerging from the mountains near Great Falls, Montana. It flows east across the plains of Montana into North Dakota, then turns southeast flowing into South Dakota and along the north and eastern edge of Nebraska. The river forms part of Nebraska's border with South Dakota and nearly its entire boundary with Iowa, flowing past Sioux City and Omaha. The river forms the entire boundary between Nebraska and Missouri and part of the boundary between Missouri and Kansas. At Kansas City, the river turns eastward and flows across Missouri where it joins the Mississippi River just north of St. Louis. The Missouri River sub-basin is the largest sub-basin in the Mississippi River basin, covering more than 500,000 square miles.

The TMDL discussed in this report is for the portion of the Missouri River that begins on the border of Iowa and Missouri, approximately 10 miles north of Watson, Missouri, at River Mile 552 (Figure 1). Table A in the appendix provides a detailed description of the 25 sampling locations along the Missouri River shown in Figure 1. Land use for this 533-mile portion<sup>3</sup> of the Missouri River is shown in Figure 2. Within the impaired segments, three major tributaries enter the Missouri River. These tributaries are the Platte, Blue and Osage Rivers, and their confluences are at Missouri River Miles 391, 358 and 133, respectively. Table 1 summarizes the information on the impaired segments in the Missouri River based on the 2002 303(d) listing.

**Table 1: Missouri 2002 303(d) List for Impaired Segments in Missouri River**

| WBID | Waterbody      | Size | Unit  | Pollutant       | Downstream County | Upstream County | Priority |
|------|----------------|------|-------|-----------------|-------------------|-----------------|----------|
| 1604 | Missouri River | 100  | Miles | Chlordane, PCBs | St. Louis         | Gasconade       | High     |
| 701  | Missouri River | 129  | Miles | Chlordane, PCBs | Gasconade         | Chariton        | High     |
| 356  | Missouri River | 125  | Miles | Chlordane, PCBs | Chariton          | Jackson         | High     |
| 226  | Missouri River | 179  | Miles | Chlordane, PCBs | Jackson           | Atchison        | High     |

<sup>3</sup> There is a 19-mile discrepancy between the length of the river (from the Iowa state line to the Mississippi) as recorded in the WQS vs. the mile marker on the river itself at the Iowa line. This amounts to a 3.4 percent difference, which is well within the acceptable standard deviation. However, as ArcView becomes more accurate, the river will be re-measured and in due time this will be reflected in the WQS.



**Figure 1: Location Map for Impaired Segments in Missouri River**

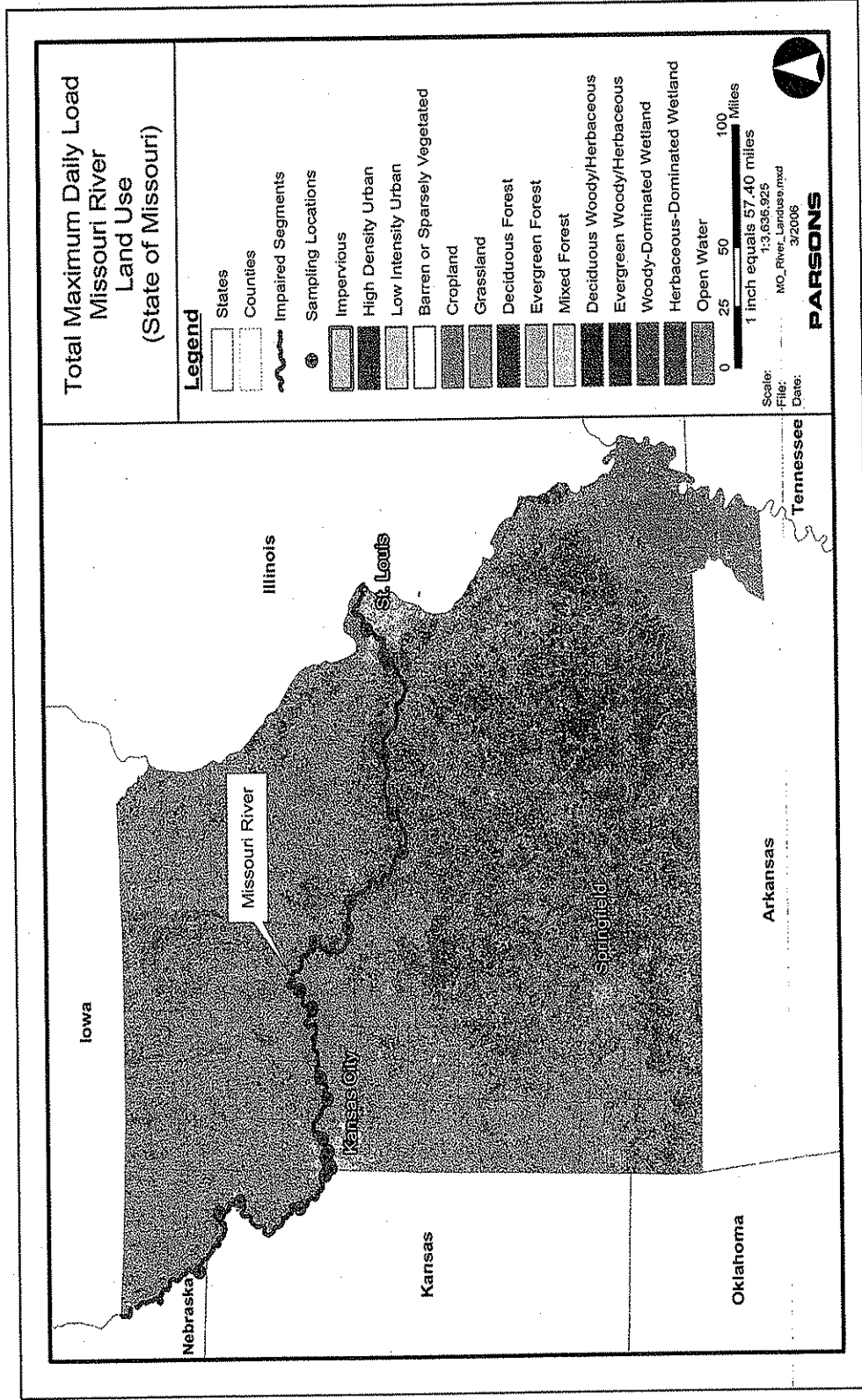


Figure 2: Land Use for Missouri River Watershed within State of Missouri

### **1.2 Fish Advisories in Missouri:**

The Missouri Department of Conservation (MDC) has monitored levels of toxic contaminants in fish from Missouri lakes and rivers since 1984. At that time, MDC discovered elevated levels of chlordane in fish in the Missouri, Mississippi and Meramec rivers. MDC, the U.S. Environmental Protection Agency (EPA) and the department all provide fish tissue sample results to the Missouri Department of Health and Senior Services (DHSS) for use in determining health risks to fish consumers. DHSS, in turn, issues fish consumption advisories. DHSS has issued advisories based on pesticide contaminants in fish since 1985. Past DHSS fish advisories instructed anglers to limit consumption of fatty fish (carp, catfish, buffalo, drum, suckers and paddlefish) to one meal per week. This advisory was rescinded in 2001. Trout also have a high level of fat, but are considered safe to eat from anywhere in the state. In 2002, sturgeon eggs were added to the only existing PCB advisory, which has been in place for sturgeon meat from the Missouri River since 1997.

DHSS issues its fish advisory every year around March or April. The advisory is made available to the public through press releases and may be accessed by calling DHSS at 1-866-628-9891. These advisories are also distributed to all Missouri county health departments and are posted on the Internet. The 2006 advisory may be found at [www.dhss.mo.gov/NewsAndPublicNotices/06FishAdvisory.pdf](http://www.dhss.mo.gov/NewsAndPublicNotices/06FishAdvisory.pdf).

## **2. Description of the Applicable Water Quality Standards**

### **2.1 Beneficial or Designated Uses:**

These uses are listed on page one. The use that is impaired is protection of warm water aquatic life and human health associated with fish consumption.

### **2.2 Anti-degradation Policy:**

Missouri's WQS include EPA's "three-tiered" approach to anti-degradation and may be found at 10 CSR 20-7.031(2).

Tier 1 – Protects existing uses and provides the absolute floor of water quality for all waters of the United States. Existing instream water uses are those uses that were attained on or after Nov. 29, 1975, the date of EPA's first WQS regulation, or uses for which existing water quality is suitable unless prevented by physical problems such as substrate or flow.

Tier 2 – Protects the level of water quality necessary to support propagation of fish, shellfish and wildlife and recreation in and on the water in waters that are currently of higher quality than required to support these uses. Before water quality in Tier 2 waters can be lowered, there must be an anti-degradation review consisting of: (1) a finding that it is necessary to accommodate important economical or social development in the area where the waters are located; (2) full satisfaction of all intergovernmental coordination and public participation provisions; and (3) assurance that the highest statutory and regulatory requirements for point sources and best management practices for nonpoint sources are achieved. Furthermore, water quality may not be lowered to less than the level necessary to fully protect the "fishable/swimmable" uses and other existing uses.

Tier 3 – Protects the quality of outstanding national resources, such as waters of national and state parks, wildlife refuges and water of exceptional recreational or ecological significance. There may be no new or increased discharges to these waters and no new or increased discharges to tributaries of these waters that would result in lower water quality (with the exception of some limited activities that result in temporary and short-term changes in water quality).

## 2.3 Specific Criteria:

### 2.3.1 Chlordane

The specific criteria for chlordane are found in Missouri's Water Quality Standards, 10 CSR 20-7.031, Table A, under Persistent, Bioaccumulative, Man-made Toxics. The limit for chlordane *in water* related to human health protection associated with fish consumption is 0.00048 micrograms per liter ( $\mu\text{g/L}$  or parts per billion). However, elevated chlordane levels in water are not the problem. As chlordane tends to bioaccumulate in fish, this TMDL will be based on fish tissue chlordane levels. Fish tissue levels refer to the amount of chlordane in the fillet, or edible portion, of fish. The U.S. Food and Drug Administration (FDA) developed a fish tissue action level of 0.3 milligrams per kilogram ( $\text{mg/kg}$  or parts per million) for technical grade chlordane. Note: 1 kilogram equals approximately 2.2 pounds. However, the department and DHSS use the action level of 0.1  $\text{mg/kg}$  sum-of-the-isomers of chlordane.<sup>4</sup> If the level of a toxic contaminant exceeds this action level or the unrestricted consumption level, a fish consumption limit advisory that provides a risk-based, safe consumption level for target populations is issued regarding the potential health risk associated with long-term consumption of contaminated fish.

### 2.3.2 PCBs

The specific criteria for PCBs are found in Missouri's WQS, 10 CSR 20-7.031, Table A, under Persistent, Bioaccumulative, Man-made Toxics. The limit for PCBs *in water* related to human health protection associated with fish consumption is 0.000045  $\mu\text{g/L}$ . The FDA set a 2.0  $\text{mg/kg}$  limit on PCBs in fish tissue for interstate shipment of fish for human consumption. DHSS currently uses this number to issue fish advisories related to PCBs and the department uses the same number to judge impairment of Missouri water bodies by PCBs. However, DHSS has a revised fish advisory methodology that follows EPA guidance, so the threshold value for PCBs will change. The new threshold value for unrestricted consumption is expected to be 0.04  $\text{mg/kg}$  of total PCBs in fish tissue. Following adoption of these new guidelines by DHSS, the next state 303(d) listing methodology document will acknowledge them and may be revised accordingly.

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<sup>4</sup> Data can be collected as technical chlordane or sum-of-the-isomers of chlordane, in which case the action level is 0.1  $\text{mg/kg}$ . Sum-of-the-isomers of chlordane is usually comparable to FDA's action level of 0.3  $\text{mg/kg}$  technical grade chlordane when the contamination is recent, because there is a lot of the technical chlordane still present. However, after a few years the comparison no longer works well. The department, MDC, EPA and DHSS quantify chlordane by summing the following four chlordane isomers: cis-chlordane, trans-chlordane, cis-nonachlor and trans-nonachlor.

### **3. Current Water Quality Condition and Desired Endpoint**

#### **3.1 Current Water Quality Condition:**

Several agencies collected fish tissue samples at numerous monitoring sites along the Missouri River from 1976 to 2004. The goal of the fish tissue monitoring and survey program was to analyze fish tissue samples for chlordane and PCBs in order to define water body segments impacted by contamination. Bottom feeding fish such as carp were sampled because of their feeding or dwelling preferences near the bottom of the water column where chlordane and PCBs remain in the sediments.

Even though they have been banned, both chlordane and PCBs degrade very slowly, making them particularly persistent in the environment. They remain in the soil for long periods of time. Because these pollutants are not soluble they are not readily found in the water column. Instead they adsorb to soil particles in lakebed or streambed sediments. Bottom-feeding fish, such as carp, become exposed to chlordane and PCBs due to their feeding and dwelling preferences near streambeds or lakebeds where contaminated sediments persist. Fish uptake these pollutants in water through their gills and through the consumption of contaminated aquatic organisms. Once the pollutants are absorbed into the bloodstream, they accumulate primarily in fatty tissues. Once in the fatty tissues, the pollutants have the ability to biomagnify, or increase in concentration, as the compound is transferred through the food chain. These fish include fatty fish, such as carp, catfish, buffalo, drum, suckers and paddlefish.

#### **3.2 TMDL Endpoint:**

The department uses threshold levels of 0.1 mg/kg of chlordane (sum of isomers) and 2.0 mg/kg of total PCBs in fish tissue to determine support of the designated use. As just stated, because DHSS has a revised fish advisory methodology that follows EPA guidance, the threshold value for PCBs will change. The new threshold value for unrestricted consumption will be 0.04 mg/kg of total PCBs in fish tissue. If the average levels of these compounds exceed these levels in fillets of the fish sampled, the water body is considered to be not supporting the fish consumption use. These will be used for the endpoints for these TMDLs and the achievement of these targets should lead to the removal of fish consumption advisories. Missouri's protocol for removing or down grading an advisory requires at least two years of data below these targets.

### **4. Source Inventory and Assessment**

#### **4.1 Chlordane:**

Chlordane has been identified as a pollutant of concern because it is a bio-accumulative pesticide that is carcinogenic and can cause both acute and chronic toxic effects. Its polycyclic chlorinated organic structure produces deleterious biological effects similar to those of DDT, PCBs and other related substances (MDE, 2000).

Chlordane is a manufactured chemical that was used as a pesticide in the U.S. from 1948 to 1988 (ATSDR, 1995). Since its introduction in the 1940s, chlordane was used as a broad-spectrum pesticide for agricultural, home and commercial control of insects until it was withdrawn from the



market in 1988. The original source of chlordane was runoff, particularly from urban areas where widespread termite eradication occurred around homes in the 1970s and 1980s. Chlordane was also used at nurseries, on golf courses and in agriculture. Chlordane was banned for agricultural use in 1975 and for all uses in 1988; therefore, no additional loading should occur. Some of its trade names include Oktachlor and Velsicol 1068 (ATSDR, 1995). At the height of production, chlordane was the second most widely used organochlorine insecticide in the U.S., with annual production of about 11 million kg/year. Production in the U.S. in 1974 amounted to 9.5 million kg (IPCS, 1988). Over 70,000 tons of chlordane has been manufactured since 1946 (U.S. EPA, 1998).

As previously mentioned, chlordane degrades very slowly, and thus is extremely persistent in the environment (with the ability to stay in the soil for over 20 years). It bio-accumulates in the tissue of bottom-feeding fish (such as carp) which become exposed to chlordane due to their feeding or dwelling preferences near chlordane-contaminated sediments. Eating fish contaminated by chlordane will not make a person immediately ill. However, over a long period of time, chlordane may damage the nervous system, digestive system and the liver (MDNR, 2001).

The department recognizes that there is still chlordane in products in storage sheds, barns and basements. It is possible that chlordane could still find its way into the environment through leaks, use of the product or improper disposal. However, it is estimated that the amount that might actually reach the river is negligible.<sup>5</sup> The reasons for this are: 1) since it has been banned since 1988, the number of people who still have a product containing chlordane is small, 2) chlordane would be only a small portion of the ingredients in the product, 3) The number of people who would use the product is smaller yet and 4) if applied according to directions, it should not cause a problem. Overall, there is no reason to expect that the levels of chlordane in the environment, and therefore chlordane levels in fish tissue, will do anything but decline in the future.

#### **4.2 Polychlorinated Biphenyls (PCBs):**

PCBs are a mixture of up to 200 different chlorinated compounds and are stable under conditions of high pressure and high temperature. PCBs are manmade compounds that have been used commercially since 1929. These chemicals were manufactured as combinations of chlorinated biphenyls that differed according to the percentage of chlorine in the mixture. PCBs had a wide variety of industrial applications due to their chemical stability and flame resistance. However, these characteristics also enabled them to remain highly persistent in the environment. PCBs were commonly used as plasticizers, heat-transfer fluids, solvent extenders, hydraulic fluids, flame retardants, sealers, ink carriers, organic diluents and dielectric fluids. They are found in transformers, capacitors, florescent lighting fixtures, televisions, computers, microscope oil, hydraulic oil, caulking compounds and elastic sealant made from 1966 to 1975. The manufacturing of PCBs stopped in the United States in 1977 due to concerns about the persistence of PCBs in the environment and evidence that they bioaccumulate, which can cause harmful health effects.

U.S. industry purchased approximately 1.25 billion pounds of PCBs by the time production stopped in 1977 (U.S. EPA, 1993). EPA estimates that 60 percent, or 750 million pounds, of PCBs produced are still in use in the U.S. in approximately 150,000 PCB transformers and 2.5 million mineral oil transformers (Graham, 1987). Another 36 percent (450 million pounds) of PCBs were

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<sup>5</sup> Personnel correspondence with Paul Andre, Missouri Department of Agriculture, Pesticide Program, 7/06.

either placed in landfills or dumps or were available to biota via air, water, soil and sediments. The remaining four percent (55 million pounds) were destroyed by incineration or were degraded in the environment (U.S. EPA, 1993). Monsanto Chemical Company in Sauget, Illinois, produced approximately 99 percent of commercial PCBs for U.S. industry and sold the compounds under the trade name Aroclor (ATSDR, 1995a). A four digit numbering code identifies the Aroclors. The first two digits denote the number of carbon atoms in the biphenyl group and the last two digits represent the approximate percentage of chlorine in the mixture. The most common PCBs manufactured include Aroclor 1242, Aroclor 1248, Aroclor 1254 and Aroclor 1260 (Cairns et. al., 1986).

The behavior of PCBs differs depending on the number of chlorine atoms present. Generally, these compounds are relatively insoluble and have the ability to absorb strongly into organic matter. As the chlorine content increases, the solubility of the compounds decrease and the mixture becomes more viscous. PCBs are highly lipophilic (fat loving) and bio-accumulate in fish tissue, which can result in very high concentrations that are unsafe for human consumption (U.S. EPA, 1980). Currently, the primary source of PCB ingestion is through the consumption of contaminated fish (USDHHS, 1995). Fish uptake of PCBs in water through their gills and through the consumption of contaminated aquatic organisms. As with chlordane, PCBs are absorbed into the bloodstream and accumulate primarily in fatty tissues. In these fatty tissues, they have the ability to biomagnify or increase in concentration, as the compound is transferred through the food chain. In humans and other mammals, PCBs accumulate in the gastrointestinal tract, adipose (fatty) tissue and skin.

As already stated, U.S. production of PCBs ended in 1977 because of the evidence that they accumulate in the environment, which can cause harmful health effects. Although production of PCBs was banned, note that the ban was on the manufacture, processing, and distribution in commerce of PCBs. The ban did not extend to existing products containing PCBs, such as transformers. Poorly maintained hazardous waste sites that contain PCBs, industrial and municipal incinerators burning organic waste, illegal or improper dumping of PCB wastes (such as transformer fluids and some capacitors) and leaks from electrical transformers continue to release PCBs into the environment. However, since PCBs are no longer produced, a downward trend in the environment is inevitable.

## **5. Determination of TMDL and Allocation<sup>6</sup>**

The following equation was used to calculate the TMDL.

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS} \quad (\text{Eq. 1})$$

where:

- TMDL: Total Maximum Daily Load
- WLA: Waste Load Allocation (for point sources)
- LA: Load Allocation (for non-point sources)
- MOS: Margin of Safety (to account for uncertainties)

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<sup>6</sup> Calculations and graphs by Parsons Corporation, a Pasadena-based engineering and construction firm

### **5.1 TMDL/Loading Capacity:**

TMDL or loading capacity is defined as the maximum pollutant load that a water body can assimilate and still attain WQS. EPA banned the use of chlordane in 1988. While the department recognizes that there is still chlordane in existence that is unaccounted for, with the potential to enter the river system, the amount that might actually reach the river is believed to be negligible (see section 4.1). Again, there is no reason to expect that the levels of chlordane in the environment and in fish tissue will do anything but decline in the future. Therefore, the TMDL for chlordane in the 533 mile impaired segment along the Missouri River is set as zero pounds/day.

Similarly, EPA banned the use of PCBs in 1977. Again, the department acknowledges that there is the potential for a certain amount of PCBs to leak into the environment (see Source Inventory-PCBs above). However, judging from the available data, that amount is deemed to be small and declining. Therefore, the TMDL for PCBs in the 533 mile impaired segment along the Missouri River is set as zero pounds/day.

### **5.2 Waste Load Allocation:**

As stated earlier, these two compounds are mainly a sediment issue and amounts in the water column are virtually non-detectable. There are no Missouri facilities which discharge either directly to the Missouri River or to a tributary where the Missouri River is the first classified water body, that have that potential for discharging detectable amounts of PCBs or chlordane. Since chlordane and PCBs were banned in 1988 and 1977, respectively, there should be negligible discharge of chlordane and PCBs into streams from wastewater treatment plants and other point sources. Therefore, the WLA is set as zero pounds/day in this TMDL.

### **5.3 Load Allocation:**

Since chlordane and PCBs were banned, there will be only minor and/or infrequent application of chlordane anywhere that might be discharged under runoff conditions and enter the river. As time passes, this, too, will decline. Therefore, the LA is set as zero pounds/day in this TMDL.

### **5.4 Margin of Safety:**

In order to ensure there is no threat of chlordane and PCB levels impairing fish consumption, fish advisories will remain in effect until all samples taken from fish have met the desired endpoint for two years. The department will coordinate with DHSS in guarding against threats to human health associated with fish consumption from these two contaminants.

### **5.5 Seasonal Variation:**

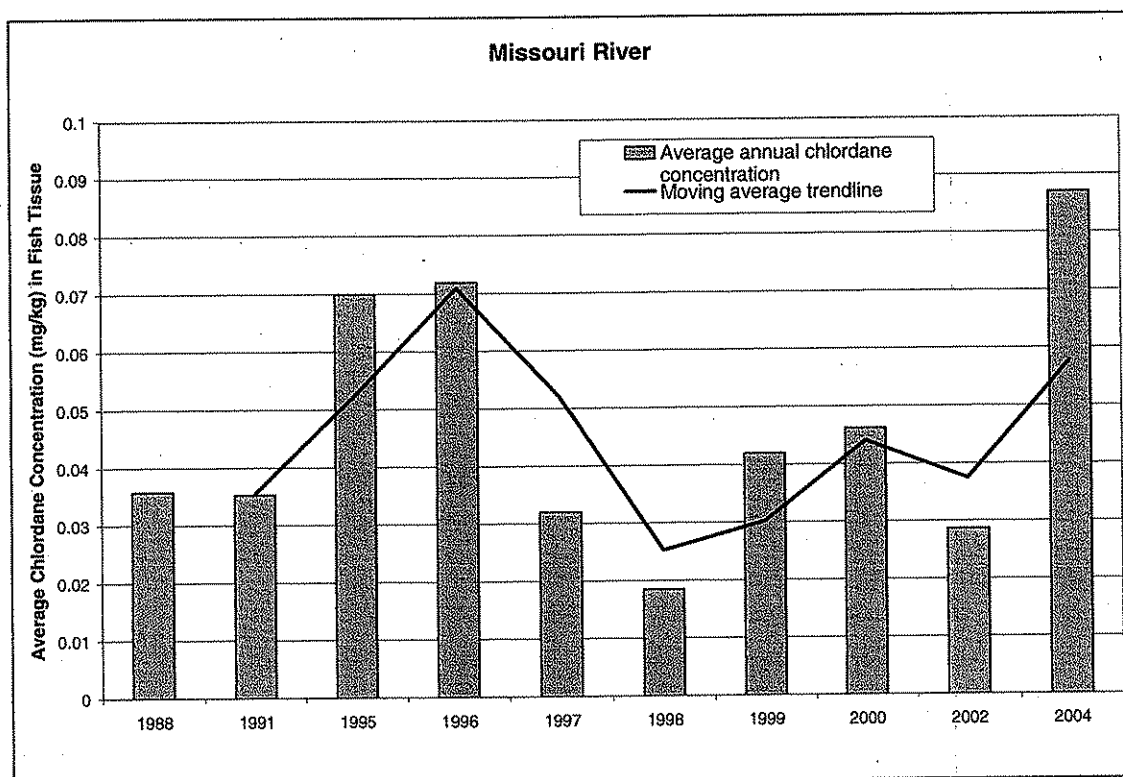
There is no seasonal variation associated with this TMDL.

## **6. Implementation**

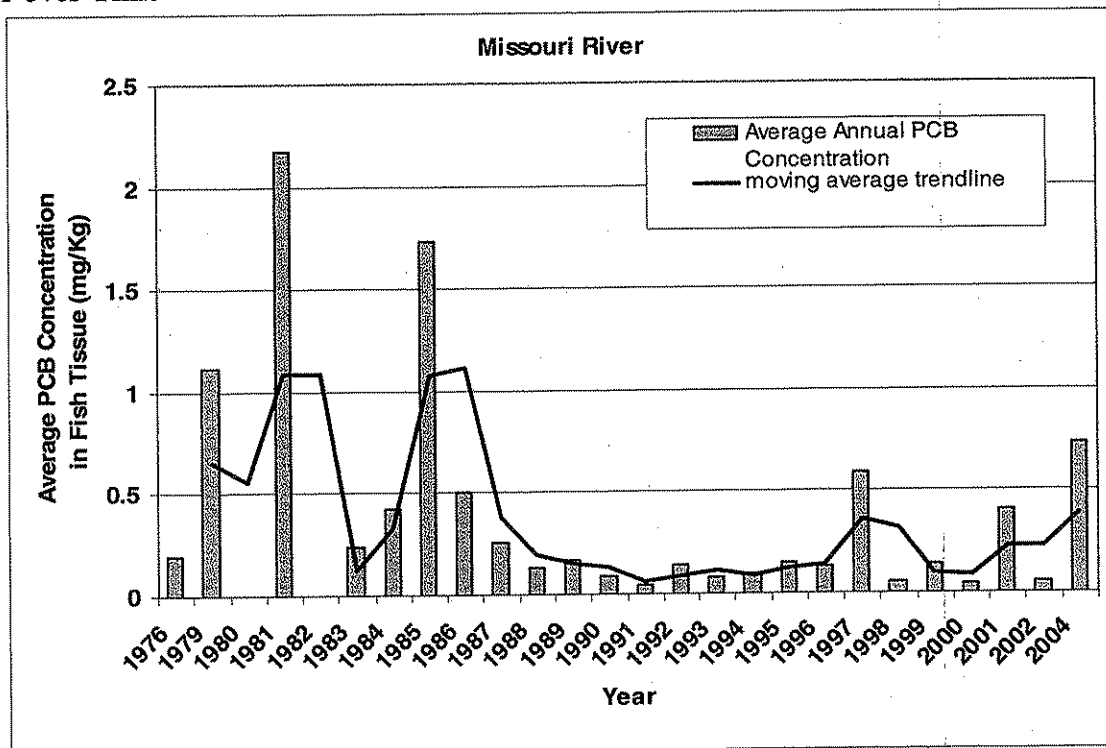
Since chlordane and PCBs have been banned, there is no specific remediation plan for this impairment. In regard to existing stores, stashes and unused inventory of these products, Missouri continues to collect them as they are turned in for proper disposal through various hazardous waste and hazardous household waste disposal initiatives. A major source of PCBs is transformers. Transformer fluid is tested and properly disposed of as the transformer ends its useful life.

Otherwise, fish tissue concentrations are declining as chlordane and PCBs are purged or degraded in water body sediments over time. Figures 3 and 4 show the average annual chlordane and PCB concentrations and their corresponding moving average trends.

**Figure 3: Average Annual Chlordane Concentration (as Sum-of-the-Isomers) and Three-Year Moving Average in Missouri River over Time**



**Figure 4: Average Annual PCB Concentration and Three-Year Moving Average in Missouri River over Time**



The department recognizes that data collected to date do not always reflect a downward trend of PCBs or chlordane on a year-to-year basis; however, that this is most likely due to collection inconsistencies. Some years of data contain tissue samples of many different fish species, but some years contain only one or two species of fish. Fatty fish, such as carp, tend to absorb more PCBs than a less fatty fish such as catfish. Likewise, feeding habits, rainfall and age and size of the fish can effect the amount of sediment (thus PCBs and chlordane) assimilated by fish or the bio-accumulative effect. The most recent data predominately sampled catfish and sturgeon, however in 2004, only sturgeon was sampled. This would tend to show increasing levels of PCBs and chlordane in later years and obscure the overall downward trend. When only fillets are considered, from the year 2000 to the present, concentrations of both compounds are consistently below the stated action levels.

As mentioned, these pollutants degrade slowly and are extremely persistent in the environment. However, since they are no longer produced, a downward trend is inevitable and this TMDL recommends development of a consistent protocol for measurement of the pollutants in fish tissue and continued sampling.

This is a phased TMDL, which means that if future data indicates fish tissue chlordane and PCB levels are not continuing to decline, this TMDL will be re-evaluated. This TMDL will be incorporated into Missouri's Water Quality Management Plan.

## 7. Public Participation

This TMDL was on public notice from June 9 to July 9, 2006. Due to comments received during the first notice period, which resulted in substantial changes to the TMDL document, a second public notice period was needed. This period was from Aug. 30 to Sept. 29, 2006. Groups who received the public notice announcement included the Missouri Clean Water Commission, the Water Quality Coordinating Committee, the water quality departments in neighboring states where the Missouri River is a shared border (Kansas and Nebraska), the 155 Stream Team volunteers in the watershed, and the 51 legislators representing all the counties bordering this river. Also, the department posted the notice, the Missouri River Information Sheet and this document on its Web site, making them available to anyone with access to the Web. The department has placed a copy of the notice, the comments received and its responses in the Missouri River file.

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**Appendix**

**Table A: Sampling Locations along Missouri River**

**Table B: Missouri River Fish Tissue Data**



**Table A: Sampling Locations along Missouri River**

| Number | Location       | Station Name                     | River Mile | Latitude | Longitude | Data Source                      |
|--------|----------------|----------------------------------|------------|----------|-----------|----------------------------------|
| 1      | Missouri River | Rulo, Nebraska                   | RM 498     | 40.0394  | -95.4144  | NDEQ                             |
| 2      | Missouri River | below Nodaway River, Missouri    | RM 462.6   | 39.9003  | -94.96022 | MDC                              |
| 3      | Missouri River | Nodaway Island Access, Missouri  | RM 462.1   | 39.9013  | -94.9531  | MDC                              |
| 4      | Missouri River | St. Joseph, Missouri             | RM 448.2   | 39.754   | -94.858   | EPA/MDNR<br>USEPA<br>MDC         |
| 5      | Missouri River | Leavenworth, Kansas              | RM 397     | 39.3291  | -94.9085  | USEPA<br>MDC<br>USGS             |
| 6      | Missouri River | Kansas City, Missouri            | RM 365.8   | 39.1194  | -94.534   | EPA/MDNR<br>USEPA<br>MDC<br>USGS |
| 7      | Missouri River | below I-635, Missouri            | RM 374     | 39.1531  | -94.6495  | USEPA<br>MDC                     |
| 8      | Missouri River | below US 169, Missouri           | RM 365.9   | 39.113   | -94.586   | USEPA                            |
| 9      | Missouri River | above Hwy 269, Missouri          | RM 363     | 39.1387  | -94.5424  | USEPA                            |
| 10     | Missouri River | above I-435, Missouri            | RM 361     | 39.1515  | -94.5117  | USEPA                            |
| 11     | Missouri River | below Blue Ridge Blvd., Missouri | RM 358     | 39.1291  | -94.4686  | USEPA<br>EPA/MDNR<br>MDC         |
| 12     | Missouri River | near Shoal Creek, Missouri       | RM 351.8   | 39.168   | -94.3723  | USEPA<br>MDC                     |
| 13     | Missouri River | Napolean, Missouri               | RM 329.2   | 39.1342  | -94.0645  | MDC                              |
| 14     | Missouri River | Lexington, Missouri              | RM 317.3   | 39.1869  | -93.8965  | EPA/MDNR<br>USEPA<br>MDC         |
| 15     | Missouri River | near Malta Bend, Missouri        | RM 275.3   | 39.2382  | -93.3614  | MDC                              |
| 16     | Missouri River | Miami, Missouri                  | RM 262.7   | 39.3289  | -93.2252  | MDC                              |
| 17     | Missouri River | Glasgow, Missouri                | RM 226.5   | 39.2223  | -92.8505  | MDC                              |
| 19     | Missouri River | Boonville, Missouri              | RM 196.7   | 38.9812  | -92.7456  | MDC                              |

**Table A: Sampling Locations along Missouri River**

| Number | Location       | Station Name                | River Mile | Latitude | Longitude   | Data Source       |
|--------|----------------|-----------------------------|------------|----------|-------------|-------------------|
| 19     | Missouri       | near Columbia,              | RM 185     | 38.9597  | -92.545     | EPA/MDNR          |
| 20     | Missouri River | Jefferson City, Missouri    | RM 143.2   | 38.5875  | -92.1788    | USEPA MDC         |
| 21     | Missouri River | Mokane, Missouri            | RM 123.4   | 38.6519  | -91.8831    | MDC               |
| 22     | Missouri River | Hermann, Missouri           | RM 97.9    | 38.71    | -91.4391022 | EPA/MDNR MDC USGS |
| 23     | Missouri River | Weldon Springs CA, Missouri | RM 44.1    | 38.6565  | -90.7332    | MDC               |
| 24     | Missouri River | Chesterfield, Missouri      | RM 39      | 38.6874  | -90.6627    | USPHS MDC         |
| 25     | Missouri River | St. Charles, Missouri       | RM 28.2    | 38.7984  | -90.4662    | MDC               |

**Table B: Missouri River Fish Tissue Data for Sum of the Isomers (SOI) of Chlordane and PCBs from 1976 to 2004**

Note: For use in calculations, the original data were adjusted as follows: Where the data were recorded as "less than" values, half that value is used. Where data were recorded as "Trace amount", zero (0) is used. The SOI Chlor and PCB columns below reflect these adjustments. The units for both are milligrams per kilogram (mg/kg).

| Org      | Site      | WBID | Site Name                     | Date | Species | County    | Type | # in sample | SOI Chlor | PCB   |
|----------|-----------|------|-------------------------------|------|---------|-----------|------|-------------|-----------|-------|
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1976 | CAT     | COOPER    |      | 6           |           | 0.81  |
| USEPA    | 701/39.5  | 701  | Missouri R. @ Jefferson City  | 1976 | MIXED   | COLE      |      |             |           | 0.462 |
| USEPA    | 701/39.5  | 701  | Missouri R. @ Jefferson City  | 1976 | RED     | COLE      |      | 1           |           | 0.161 |
| USEPA    | 701/39.5  | 701  | Missouri R. @ Jefferson City  | 1976 | FH CAT  | COLE      |      | 1           |           | 0     |
| USEPA    | 701/39.5  | 701  | Missouri R. @ Jefferson City  | 1976 | G EYE   | COLE      |      | 1           |           | 0.448 |
| USEPA    | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1976 | CARP    | BUCHANAN  |      | 1           |           | 0.12  |
| USEPA    | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1976 | G EYE   | BUCHANAN  |      | 4           |           | 0.281 |
| USEPA    | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1976 | S GAR   | BUCHANAN  |      | 1           |           | 0.086 |
| USEPA    | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1976 | CARPSU  | BUCHANAN  |      | 3           |           | 0.166 |
| USEPA    | u         | 356  | MO R. KC                      | 1976 | CARP    |           |      | 1           |           | 0.344 |
| USEPA    | u         | 356  | MO R. KC                      | 1976 | G SHAD  |           |      | 3           |           | 0.751 |
| USEPA    | u         | 356  | MO R. KC                      | 1976 | BUF     |           |      | 2           |           | 0.121 |
| USEPA    | u         | 356  | MO R. KC                      | 1976 | B CRA   |           |      | 1           |           | 0     |
| USGS     | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1979 | SM BUF  | GASCONADE | W    | 1           |           | 0.9   |
| USGS     | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1979 | CARPSU  | GASCONADE | W    | 1           |           | 2.2   |
| USGS     | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1979 | CARPSU  | GASCONADE | W    | 1           |           | 1.7   |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1980 | B BUF   | GASCONADE | W    | 5           |           | 0     |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1980 | CARP    | BUCHANAN  | W    | 5           |           | 0     |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1981 | CARP    | GASCONADE | W    | 5           |           | 0     |

*Total Maximum Daily Load for Missouri River - Appendix*

|          |           |      |                               |      |        |           |   |    |  |       |
|----------|-----------|------|-------------------------------|------|--------|-----------|---|----|--|-------|
| USEPA    | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1981 | CARP   | PLATTE    | W | 5  |  | 0     |
| USEPA    | 356/77.4  | 356  | Missouri R. @ Lexington       | 1981 | CARP   | LAFAYETTE | W | 5  |  | 0     |
| USEPA    | 356/77.4  | 356  | Missouri R. @ Lexington       | 1981 | CARP   | LAFAYETTE | W | 3  |  | 0     |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1981 | CARP   | BUCHANAN  | W | 5  |  | 0     |
| EPA/MDNR | u         | 356  | MO R. KC                      | 1981 | CARP   |           | W | 5  |  | 0     |
| USEPA    | u         | 356  | MO R. KC                      | 1981 | CARP   |           | W | 5  |  | 0     |
| USEPA    | u         | 356  | MO R. KC                      | 1981 | CARP   |           | W | 6  |  | 22.3  |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1982 | B BUF  | GASCONADE | W | 5  |  | 0     |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1982 | CARP   | BUCHANAN  | W | 5  |  | 0     |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1983 | CARP   | GASCONADE | W | 3  |  | 0.24  |
| USEPA    | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1983 |        | PLATTE    | W |    |  | 0     |
| USEPA    | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1983 |        | BUCHANAN  | W |    |  | 0     |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1983 | CARP   | BUCHANAN  | W | 5  |  | 0     |
| EPA/MDNR | u         | 356  | MO R. KC                      | 1983 | CARP   |           | W | 6  |  | 0     |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1984 | CARP   | GASCONADE | W | 1  |  | 0.054 |
| EPA/MDNR | 356/77.4  | 356  | Missouri R. @ Lexington       | 1984 | CARP   | LAFAYETTE | W | 5  |  | 0     |
| EPA/MDNR | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1984 | CH CAT | BOONE     | F | 20 |  | 0.077 |
| EPA/MDNR | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1984 | CARPSU | BOONE     | F | 20 |  | 0.254 |
| EPA/MDNR | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1984 | FH CAT | BOONE     | F | 20 |  | 0.095 |
| EPA/MDNR | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1984 | SHSTUR | BOONE     | F | 20 |  | 2.52  |
| EPA/MDNR | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1984 | CARP   | BOONE     | F | 14 |  | 0.058 |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1984 | CARP   | BUCHANAN  | W | 7  |  | 0     |
| EPA/MDNR | u         | 356  | MO R. KC                      | 1984 | CARP   |           | W | 5  |  | 2.11  |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1985 | CARP   | GASCONADE | W | 3  |  | 0.159 |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1985 | CARP   | GASCONADE | W | 3  |  | 0.285 |
| EPA/MDNR | 356/77.4  | 356  | Missouri R. @ Lexington       | 1985 | CARP   | LAFAYETTE | W | 5  |  | 0.53  |
| EPA/MDNR | 356/77.4  | 356  | Missouri R. @ Lexington       | 1985 | CARP   | LAFAYETTE | W | 5  |  | 0     |
| EPA/MDNR | u         | 356  | MO R. KC                      | 1985 | CARP   |           | W | 4  |  | 5.11  |
| EPA/MDNR | u         | 356  | MO R. KC                      | 1985 | CARP   |           | W | 3  |  | 7.49  |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1986 | CARP   | GASCONADE | W | 6  |  | 0.075 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | CH CAT | BOONE     | F |    |  | 0.075 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | BUF    | BOONE     | F |    |  | 0.075 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | SHSTUR | BOONE     | E |    |  | 1.807 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | CARP   | BOONE     | F |    |  | 0.075 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | SHSTUR | BOONE     | F |    |  | 0.551 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | SHSTUR | BOONE     | E |    |  | 1.039 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | SHSTUR | BOONE     | E |    |  | 1.512 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | SHSTUR | BOONE     | E |    |  | 1.131 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | SHSTUR | BOONE     | E |    |  | 2.363 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | W BASS | BOONE     | F |    |  | 0.075 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | SHSTUR | BOONE     | F |    |  | 1.265 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | SHSTUR | BOONE     | F |    |  | 0.493 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | CARPSU | BOONE     | F |    |  | 0.356 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | DRUM   | BOONE     | F |    |  | 0.123 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | SHSTUR | BOONE     | F |    |  | 0.578 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1986 | SHSTUR | BOONE     | F |    |  | 0.316 |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1986 | CARP   | BUCHANAN  | W | 5  |  | 0.13  |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1986 | CARP   | BUCHANAN  | W | 5  |  | 0.13  |
| EPA/MDNR | u         | 356  | MO R. KC                      | 1986 | CARP   |           | W | 5  |  | 1.225 |
| EPA/MDNR | u         | 356  | MO R. KC                      | 1986 | CARP   |           | W | 5  |  | 2.165 |
| MDC      | u         | 356  | MO R. KC                      | 1986 | CARP   |           | F | 5  |  | 0     |
| MDC      | u         | 356  | MO R. KC                      | 1986 | CH CAT |           | F | 5  |  | 0     |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1987 | FH CAT | COOPER    | F | 1  |  | 0.274 |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1987 | FH CAT | COOPER    | F | 5  |  | 0.09  |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1987 | CH CAT | COOPER    | F | 5  |  | 0.205 |
| R        | 701/92.2  | 701  | Missouri R. @ Boonville       | 1987 | CH CAT | COOPER    | F | 5  |  | 0.092 |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1987 | CH CAT | COOPER    | F | 5  |  | 0.071 |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1987 | CH CAT | COOPER    | F | 1  |  | 0.245 |

*Total Maximum Daily Load for Missouri River - Appendix*

|          |           |      |                               |      |        |           |   |   |  |       |
|----------|-----------|------|-------------------------------|------|--------|-----------|---|---|--|-------|
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1987 | CARP   | COOPER    | F | 5 |  | 0.07  |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1987 | CARP   | COOPER    | F | 5 |  | 0.093 |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1987 | CARP   | COOPER    | F | 1 |  | 0.09  |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1987 | CARPSU | COOPER    | F | 5 |  | 0.068 |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1987 | SHSTUR | COOPER    | F | 6 |  | 0.303 |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1987 | DRUM   | COOPER    | F | 5 |  | 0.019 |
| MDC      | 1604/43.9 | 1604 | Missouri R. @ Chesterfield    | 1987 | BM BUF | ST LOUIS  | F | 5 |  | 0.025 |
| MDC      | 1604/43.9 | 1604 | Missouri R. @ Chesterfield    | 1987 | FH CAT | ST LOUIS  | F | 3 |  | 0.025 |
| MDC      | 1604/43.9 | 1604 | Missouri R. @ Chesterfield    | 1987 | CARP   | ST LOUIS  | F | 5 |  | 0.025 |
| MDC      | 1604/43.9 | 1604 | Missouri R. @ Chesterfield    | 1987 | BL CAT | ST LOUIS  | F | 3 |  | 0.121 |
| MDC      | 1604/43.9 | 1604 | Missouri R. @ Chesterfield    | 1987 | CH CAT | ST LOUIS  | F | 3 |  | 0.081 |
| MDC      | 1604/43.9 | 1604 | Missouri R. @ Chesterfield    | 1987 | CARP   | ST LOUIS  | F | 5 |  | 0.025 |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1987 | CARP   | GASCONADE | W | 2 |  | 0.122 |
| MDC      | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1987 | FH CAT | PLATTE    | F | 5 |  | 0.025 |
| MDC      | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1987 | CARP   | PLATTE    | F | 1 |  | 0.025 |
| MDC      | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1987 | CARP   | PLATTE    | F | 4 |  | 0.036 |
| MDC      | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1987 | CH CAT | PLATTE    | F | 3 |  | 0.121 |
| MDC      | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1987 | FH CAT | PLATTE    | F | 4 |  | 0.121 |
| MDC      | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1987 | CARP   | PLATTE    | F | 5 |  | 0.025 |
| MDC      | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1987 | CARP   | PLATTE    | F | 5 |  | 0.025 |
| MDC      | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1987 | CARP   | PLATTE    | F | 5 |  | 0.025 |
| MDC      | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1987 | CH CAT | PLATTE    | F | 5 |  | 0.025 |
| MDC      | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1987 | FH CAT | PLATTE    | F | 5 |  | 0.053 |
| MDC      | 356/77.4  | 356  | Missouri R. @ Lexington       | 1987 | CH CAT | LAFAYETTE | F | 5 |  | 0.025 |
| MDC      | 356/77.4  | 356  | Missouri R. @ Lexington       | 1987 | SM BUF | LAFAYETTE | F | 1 |  | 0.025 |
| MDC      | 356/77.4  | 356  | Missouri R. @ Lexington       | 1987 | FH CAT | LAFAYETTE | F | 5 |  | 0.055 |
| MDC      | 356/77.4  | 356  | Missouri R. @ Lexington       | 1987 | CARP   | LAFAYETTE | F | 5 |  | 0.139 |
| USEPA    | 356/124.2 | 356  | Missouri R. ab. Hwy. 269      | 1987 | CARP   | JACKSON   | W | 3 |  | 0.54  |
| USEPA    | 356/124.2 | 356  | Missouri R. ab. Hwy. 269      | 1987 | CARP   | JACKSON   | W | 3 |  | 0.64  |
| USEPA    | 356/122.2 | 356  | Missouri R. ab. I-435         | 1987 | CARP   | JACKSON   | W | 3 |  | 0.702 |
| USEPA    | 356/122.2 | 356  | Missouri R. ab. I-435         | 1987 | CARP   | JACKSON   | W | 3 |  | 0.425 |
| USEPA    | 356/119.2 | 356  | Missouri R. bl. Blue R.       | 1987 | CARP   | CLAY      | W | 3 |  | 3.22  |
| USEPA    | 356/119.2 | 356  | Missouri R. bl. Blue R.       | 1987 | CARP   | CLAY      | W | 3 |  | 1.26  |
| USEPA    | 226/6.7   | 226  | Missouri R. bl. I-635         | 1987 | CARP   | PLATTE    | W | 3 |  | 0.63  |
| USEPA    | 226/6.7   | 226  | Missouri R. bl. I-635         | 1987 | CARP   | PLATTE    | W | 3 |  | 0.63  |
| USEPA    | 356/127.2 | 356  | Missouri R. bl. US 169        | 1987 | CARP   | JACKSON   | W | 4 |  | 0.673 |
| USEPA    | 356/127.2 | 356  | Missouri R. bl. US 169        | 1987 | CARP   | JACKSON   | W | 5 |  | 0.395 |
| USEPA    | 356/112.7 | 356  | Missouri R. nr. Shoal Cr.     | 1987 | CARP   | CLAY      | W | 3 |  | 0.225 |
| USEPA    | 356/112.7 | 356  | Missouri R. nr. Shoal Cr.     | 1987 | CARP   | CLAY      | W | 3 |  | 0.215 |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1987 | CARP   | BUCHANAN  | W | 4 |  | 0.18  |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1987 | CARP   | BUCHANAN  | W | 4 |  | 0.279 |
| EPA/MDNR | u         | 356  | MO R. KC                      | 1987 | CARP   |           | W | 3 |  | 3     |
| MDC      | u         | 356  | MO R. KC                      | 1987 | DRUM   |           | F | 5 |  | 0.025 |
| MDC      | u         | 356  | MO R. KC                      | 1987 | FH CAT |           | F | 3 |  | 0.025 |
| EPA/MDNR | u         | 356  | MO R. KC                      | 1987 | CARP   |           | W | 3 |  | 1.335 |
| MDC      | u         | 356  | MO R. KC                      | 1987 | CH CAT |           | F | 4 |  | 0.025 |
| MDC      | u         | 356  | MO R. KC                      | 1987 | CH CAT |           | F | 4 |  | 0.092 |
| MDC      | u         | 356  | MO R. KC                      | 1987 | SHSTUR |           | F | 1 |  | 0.17  |
| MDC      | u         | 356  | MO R. KC                      | 1987 | BM BUF |           | F | 5 |  | 0.025 |
| MDC      | u         | 356  | MO R. KC                      | 1987 | SM BUF |           | F | 5 |  | 0.025 |
| MDC      | u         | 356  | MO R. KC                      | 1987 | CARPSU |           | F | 5 |  | 0.092 |
| MDC      | u         | 356  | MO R. KC                      | 1987 | CARP   |           | F | 5 |  | 0.053 |
| MDC      | u         | 356  | MO R. KC                      | 1987 | CARP   |           | F | 5 |  | 0.095 |
| MDC      | u         | 356  | MO R. KC                      | 1987 | CARP   |           | F | 5 |  | 0.079 |
| MDC      | u         | 356  | MO R. KC                      | 1987 | CH CAT |           | F | 3 |  | 0.025 |
| MDC      | u         | 356  | MO R. KC                      | 1987 | FH CAT |           | F | 4 |  | 0.025 |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1988 | CH CAT | GASCONADE | W | 4 |  | 0.31  |
| USGS     | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1988 | CARP   | PLATTE    | W | 5 |  | 0.03  |

*Total Maximum Daily Load for Missouri River - Appendix*

|          |           |      |                               |      |        |            |   |   |       |       |
|----------|-----------|------|-------------------------------|------|--------|------------|---|---|-------|-------|
| USGS     | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1988 | G EYE  | PLATTE     | W | 5 |       | 0.72  |
| USGS     | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1988 | G SHAD | PLATTE     | W | 5 |       | 0.03  |
| USGS     | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1988 | SHSTUR | PLATTE     | W | 5 |       | 0.7   |
| USGS     | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1988 | CH CAT | PLATTE     | W | 3 |       | 0.3   |
| NDEQ     | 226/NE    |      | Missouri R. @ Rulo, NE        | 1988 | CARP   |            | F | 5 | 0.049 | 0     |
| NDEQ     | 226/NE    |      | Missouri R. @ Rulo, NE        | 1988 | CH CAT |            | F | 3 | 0.052 | 0.081 |
| NDEQ     | 226/NE    |      | Missouri R. @ Rulo, NE        | 1988 | CH CAT |            | F | 3 | 0.013 | 0.43  |
| NDEQ     | 226/NE    |      | Missouri R. @ Rulo, NE        | 1988 | CH CAT |            |   | 3 | 0.03  | 0     |
| EPA/MDNR | 356/119.2 | 356  | Missouri R. bl. Blue R.       | 1988 | CARP   | CLAY       | W | 4 |       | 0.088 |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1988 | CARP   | BUCHANAN   | W | 5 |       | 0.155 |
| USGS     | u         | 356  | MO R. KC                      | 1988 | CARP   |            | W | 5 |       | 0.55  |
| USGS     | u         | 356  | MO R. KC                      | 1988 | DRUM   |            | W | 5 |       | 0.62  |
| USGS     | u         | 356  | MO R. KC                      | 1988 | CH CAT |            | W | 5 |       | 0.33  |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1989 | CARP   | COOPER     | F | 5 |       | 0.165 |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1989 | CH CAT | COOPER     | F | 5 |       | 0.111 |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1989 | FH CAT | COOPER     | F | 3 |       | 0.025 |
| MDC      | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1989 | CH CAT | GASCONADE  | F | 5 |       | 0.133 |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1989 | CARP   | GASCONADE  | W | 1 |       | 0.231 |
| MDC      | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1989 | CARP   | GASCONADE  | F | 3 |       | 0.127 |
| MDC      | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1989 | CARP   | GASCONADE  | F | 2 |       | 0.131 |
| MDC      | 701/39.5  | 701  | Missouri R. @ Jefferson City  | 1989 | CH CAT | COLE       | F | 5 |       | 0.072 |
| MDC      | 701/39.5  | 701  | Missouri R. @ Jefferson City  | 1989 | CARP   | COLE       | F | 5 |       | 0.093 |
| MDC      | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1989 | CH CAT | PLATTE     | F | 5 |       | 0.173 |
| MDC      | 226/30.1  | 226  | Missouri R. @ Leavenworth, KS | 1989 | CARP   | PLATTE     | F | 5 |       | 0.025 |
| MDC      | 1604/28.0 | 1604 | Missouri R. @ St. Charles     | 1989 | CARP   | ST CHARLES | F | 5 |       | 0.151 |
| MDC      | 1604/28.0 | 1604 | Missouri R. @ St. Charles     | 1989 | CH CAT | ST CHARLES | F | 3 |       | 0.161 |
| EPA/MDNR | 356/119.2 | 356  | Missouri R. bl. Blue R.       | 1989 | CARP   | CLAY       |   | 5 |       | 1.82  |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1989 | CH CAT | BOONE      | F | 5 |       | 0.025 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1989 | SHSTUR | BOONE      | F | 5 |       | 0.078 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1989 | CARP   | BOONE      | F | 2 |       | 0.087 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1989 | CARP   | BOONE      | F | 3 |       | 0.025 |
| MDC      | 701/80.7  | 701  | Missouri R. nr. Columbia      | 1989 | CH CAT | BOONE      | F | 2 |       | 0.025 |
| MDC      | 356/112.7 | 356  | Missouri R. nr. Shoal Cr.     | 1989 | CH CAT | CLAY       |   | 5 |       | 0.082 |
| MDC      | 356/112.7 | 356  | Missouri R. nr. Shoal Cr.     | 1989 | CARP   | CLAY       |   | 5 |       | 0.056 |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1989 | CARP   | BUCHANAN   | W | 4 |       | 0.167 |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1990 | CARP   | COOPER     | F | 5 |       | 0.1   |
| MDC      | 701/92.2  | 701  | Missouri R. @ Boonville       | 1990 | CH CAT | COOPER     | F | 5 |       | 0.025 |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1990 | CARP   | GASCONADE  | W | 3 |       | 0.367 |
| MDC      | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1990 | SHSTUR | GASCONADE  | F | 5 |       | 0.285 |
| MDC      | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1990 | CARP   | GASCONADE  | F | 5 |       | 0.106 |
| MDC      | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1990 | PADDLE | GASCONADE  | F | 1 |       | 0.025 |
| MDC      | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1990 | CH CAT | GASCONADE  | F | 5 |       | 0.192 |
| MDC      | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1990 | PADDLE | GASCONADE  | F | 1 |       | 0.025 |
| MDC      | 701/39.5  | 701  | Missouri R. @ Jefferson City  | 1990 | CARP   | COLE       | F | 5 |       | 0.025 |
| MDC      | 701/39.5  | 701  | Missouri R. @ Jefferson City  | 1990 | CH CAT | COLE       | F | 5 |       | 0.084 |
| MDC      | 226/6.7   | 226  | Missouri R. bl. I-635         | 1990 | FH CAT | PLATTE     | F | 5 |       | 0.025 |
| MDC      | 226/6.7   | 226  | Missouri R. bl. I-635         | 1990 | CARP   | PLATTE     | F | 5 |       | 0.025 |
| MDC      | 356/36.4  | 356  | Missouri R. nr. Malta Bend    | 1990 | CARP   | SALINE     |   | 5 |       | 0.091 |
| MDC      | 356/112.7 | 356  | Missouri R. nr. Shoal Cr.     | 1990 | CARP   | CLAY       | F | 5 |       | 0.124 |
| MDC      | 356/112.7 | 356  | Missouri R. nr. Shoal Cr.     | 1990 | CH CAT | CLAY       | F | 5 |       | 0.079 |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo. | 1990 | CARP   | BUCHANAN   | W | 5 |       | 0.355 |
| MDC      | 701/121.9 | 701  | Missouri R. @ Glasgow         | 1991 | CH CAT | HOWARD     |   |   |       | 0     |
| NDEQ     | 226/NE    |      | Missouri R. @ Rulo, NE        | 1991 | CH CAT |            | F | 5 | 0.035 | 0     |
| NDEQ     | 226/NE    |      | Missouri R. @ Rulo, NE        | 1992 | CH CAT |            | F | 4 |       |       |
| NDEQ     | 226/NE    |      | Missouri R. @ Rulo, NE        | 1992 | CH CAT |            | F | 4 |       |       |
| NDEQ     | 226/NE    |      | Missouri R. @ Rulo, NE        | 1992 | CH CAT |            | F | 4 |       |       |
| MDC      | 356/112.7 | 356  | Missouri R. nr. Shoal Cr.     | 1992 | CARP   | CLAY       |   | 1 |       |       |
| EPA/MDNR | 1604/97.9 | 1604 | Missouri R. @ Hermann         | 1993 | CARP   | GASCONADE  | W | 2 |       | 0.05  |



*Total Maximum Daily Load for Missouri River - Appendix*

|           |           |      |                                |      |        |            |   |    |       |       |
|-----------|-----------|------|--------------------------------|------|--------|------------|---|----|-------|-------|
| EPA/MDNR  | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1993 | CARP   | BUCHANAN   | W | 3  |       | 0.23  |
| MDC       | 356/112.7 | 356  | Missouri R. nr. Shoal Cr.      | 1994 | CARP   | CLAY       | F | 18 |       | 0.025 |
| MDC       | 356/112.7 | 356  | Missouri R. nr. Shoal Cr.      | 1994 | CARP   | CLAY       | F | 18 |       | 0.161 |
| USGS-BEST | 1604/97.9 | 1604 | Missouri R. @ Hermann          | 1995 | BASS   | GASCONADE  | W | 17 | 0.05  | 0.05  |
| USGS-BEST | 1604/97.9 | 1604 | Missouri R. @ Hermann          | 1995 | CARP   | GASCONADE  | W | 15 | 0.09  | 0.3   |
| EPA/MDNR  | 356/119.2 | 356  | Missouri R. bl. Blue R.        | 1995 | CARP   | CLAY       | W | 5  |       | 0.443 |
| EPA/MDNR  | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1995 | CARP   | BUCHANAN   | W | 5  |       | 0.079 |
| NDEQ      | 226/NE    |      | Missouri R. @ Rulo, NE         | 1996 | CH CAT |            | F | 5  | 0.03  | 0.093 |
| MDC       | 1604/28.0 | 1604 | Missouri R. @ St. Charles      | 1996 | SHSTUR | ST CHARLES | F | 13 | 0.113 | 0.025 |
| MDC       | 1604/28.0 | 1604 | Missouri R. @ St. Charles      | 1996 | SHSTUR | ST CHARLES | E |    | 0.105 | 0.025 |
| MDC       | 1604/28.0 | 1604 | Missouri R. @ St. Charles      | 1996 | CARP   | ST CHARLES | F | 23 | 0.066 | 0.112 |
| MDC       | 1604/28.0 | 1604 | Missouri R. @ St. Charles      | 1996 | CH CAT | ST CHARLES | F | 24 | 0.054 | 0.065 |
| MDC       | 701/80.7  | 701  | Missouri R. nr. Columbia       | 1996 | CARP   | BOONE      | F | 14 | 0.054 | 0.079 |
| MDC       | 701/80.7  | 701  | Missouri R. nr. Columbia       | 1996 | BUF    | BOONE      | F | 15 | 0.073 | 0.131 |
| MDC       | 701/80.7  | 701  | Missouri R. nr. Columbia       | 1996 | SHSTUR | BOONE      | F | 25 | 0.018 | 0.23  |
| MDC       | 701/80.7  | 701  | Missouri R. nr. Columbia       | 1996 | CARP   | BOONE      | F | 14 | 0.059 | 0.074 |
| MDC       | 701/80.7  | 701  | Missouri R. nr. Columbia       | 1996 | CARP   | BOONE      | F | 17 | 0.053 | 0.084 |
| MDC       | 701/80.7  | 701  | Missouri R. nr. Columbia       | 1996 | BUF    | BOONE      | F | 10 | 0.066 | 0.025 |
| MDC       | 701/80.7  | 701  | Missouri R. nr. Columbia       | 1996 | SHSTUR | BOONE      | E | 5  | 0.096 | 0.354 |
| MDC       | 701/80.7  | 701  | Missouri R. nr. Columbia       | 1996 | CH CAT | BOONE      | F | 25 | 0.073 | 0.059 |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1996 | SHSTUR | BUCHANAN   | F | 7  | 0.039 | 0.183 |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1996 | CH CAT | BUCHANAN   | F | 25 | 0.019 | 0.025 |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1996 | CARP   | BUCHANAN   | F | 17 | 0.017 | 0.025 |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1996 | SHSTUR | BUCHANAN   | E |    | 0.188 | 0.586 |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1996 | CARP   | BUCHANAN   | F | 28 | 0.032 | 0.025 |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1996 | BUF    | BUCHANAN   | F | 6  | 0.077 | 0.102 |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1996 | BUF    | BUCHANAN   | F | 11 | 0.054 | 0.025 |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1996 | SHSTUR | BUCHANAN   | F | 13 | 0.038 | 0.099 |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1996 | SHSTUR | BUCHANAN   | E |    | 0.299 | 0.698 |
| EPA/MDNR  | 356/119.2 | 356  | Missouri R. bl. Blue R.        | 1997 | CARP   | CLAY       | W | 4  |       | 1.56  |
| EPA/MDNR  | 356/119.2 | 356  | Missouri R. bl. Blue R.        | 1997 | CARP   | CLAY       | W | 3  |       | 1.26  |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1997 | CARP   | BUCHANAN   | F | 25 | 0.04  | 0.025 |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1997 | CH CAT | BUCHANAN   | F | 15 | 0.024 | 0.025 |
| EPA/MDNR  | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1997 | CARP   | BUCHANAN   | W | 4  |       | 0.092 |
| MDC       | 1604/47.5 | 1604 | Missouri R. @ Weldon Spring CA | 1998 | CARP   | ST LOUIS   | F | 25 | 0.032 | 0.083 |
| MDC       | 701/80.7  | 701  | Missouri R. nr. Columbia       | 1998 | FH CAT | BOONE      |   | 15 | 0.005 | 0.02  |
| EPA/MDNR  | 356/119.2 | 356  | Missouri R. bl. Blue R.        | 1999 | CARP   | CLAY       | W | 5  |       | 0.126 |
| EPA/MDNR  | 356/119.2 | 356  | Missouri R. bl. Blue R.        | 1999 | CARP   | CLAY       | W | 5  |       | 0.22  |
| MDC       | 701/80.7  | 701  | Missouri R. nr. Columbia       | 1999 | CARP   | BOONE      | F | 25 | 0.042 | 0.025 |
| EPA/MDNR  | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 1999 | CARP   | BUCHANAN   | W | 5  |       | 0.187 |
| MDC       | 1604/47.5 | 1604 | Missouri R. @ Weldon Spring CA | 2000 | FH CAT | ST CHARLES | F | 16 | 0.016 | 0.053 |
| MDC       | 226/93.4  | 226  | Missouri R. bl. Nodaway R.     | 2000 | CH CAT | ANDREW     |   | 15 | 0.009 | 0.009 |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 2000 | CARP   | BUCHANAN   | F | 10 | 0.092 | 0.029 |
| MDC       | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 2000 | CARP   | BUCHANAN   | F | 15 | 0.04  | 0.022 |
| EPA/MDNR  | 356/119.2 | 356  | Missouri R. bl. Blue R.        | 2001 | CARP   | CLAY       | W | 5  |       | 0.802 |
| EPA/MDNR  | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 2001 | CARP   | BUCHANAN   | W | 5  |       | 0.154 |
| EPA/MDNR  | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.  | 2001 | CARP   | BUCHANAN   | W | 5  |       | 0.262 |
| MDC       | 1604/47.5 | 1604 | Missouri R. @ Weldon Spring CA | 2002 | CARP   | ST CHARLES | F | 15 | 0.04  | 0.052 |
| MDC       | 1604/47.5 | 1604 | Missouri R. @ Weldon Spring CA | 2002 | FH CAT | ST CHARLES | F | 17 | 0.028 | 0.077 |
| MDC       | 701/80.7  | 701  | Missouri R. nr. Columbia       | 2002 | CARP   | BOONE      | F | 26 | 0.018 | 0.028 |
| MDC       | 356/23.4  | 356  | Missouri R. @ Miami            | 2004 | SHSTUR | SALINE     | F | 5  | 0.037 | 0.229 |
| MDC       | 356/23.4  | 356  | Missouri R. @ Miami            | 2004 | SHSTUR | SALINE     | F | 5  | 0.024 | 0.278 |
| MDC       | 356/23.4  | 356  | Missouri R. @ Miami            | 2004 | SHSTUR | SALINE     | F | 5  | 0.018 | 0.165 |
| MDC       | 701/19.7  | 701  | Missouri R. @ Mokane           | 2004 | SHSTUR | CALLAWAY   | E | 1  | 0.105 | 1.14  |
| MDC       | 701/19.7  | 701  | Missouri R. @ Mokane           | 2004 | SHSTUR | CALLAWAY   | E | 1  | 0.144 | 1.52  |
| MDC       | 701/19.7  | 701  | Missouri R. @ Mokane           | 2004 | SHSTUR | CALLAWAY   | F | 5  | 0.025 | 0.393 |

*Total Maximum Daily Load for Missouri River - Appendix*

|          |           |      |                                     |      |        |            |   |    |       |       |
|----------|-----------|------|-------------------------------------|------|--------|------------|---|----|-------|-------|
| MDC      | 701/19.7  | 701  | Missouri R. @ Mokane                | 2004 | SHSTUR | CALLAWAY   | F | 5  | 0.049 | 0.346 |
| MDC      | 701/19.7  | 701  | Missouri R. @ Mokane                | 2004 | SHSTUR | CALLAWAY   | F | 5  | 0.093 | 0.807 |
| MDC      | 701/19.7  | 701  | Missouri R. @ Mokane                | 2004 | SHSTUR | CALLAWAY   | E | 1  | 0.086 |       |
| MDC      | 701/19.7  | 701  | Missouri R. @ Mokane                | 2004 | SHSTUR | CALLAWAY   | E | 1  | 0.056 | 0.454 |
| MDC      | 356/87.7  | 356  | Missouri R. @ Napoleon              | 2004 | SHSTUR | LAFAYETTE  |   | 15 | 0.05  | 0.483 |
| MDC      | 356/87.7  | 356  | Missouri R. @ Napoleon              | 2004 | SHSTUR | LAFAYETTE  |   | 6  | 0.39  | 4.01  |
| MDC      | 226/99.6  | 226  | Missouri R. @ Nodaway Island Access | 2004 | SHSTUR | ANDREW     | E | 1  | 0.133 | 0.889 |
| MDC      | 226/99.6  | 226  | Missouri R. @ Nodaway Island Access | 2004 | SHSTUR | ANDREW     |   | 5  | 0.031 | 0.22  |
| MDC      | 226/99.6  | 226  | Missouri R. @ Nodaway Island Access | 2004 | SHSTUR | ANDREW     |   | 5  | 0.022 | 0.23  |
| MDC      | 226/99.6  | 226  | Missouri R. @ Nodaway Island Access | 2004 | SHSTUR | ANDREW     | E | 1  | 0.193 | 0.532 |
| MDC      | 226/99.6  | 226  | Missouri R. @ Nodaway Island Access | 2004 | SHSTUR | ANDREW     | E | 1  | 0.077 | 0.758 |
| MDC      | 226/99.6  | 226  | Missouri R. @ Nodaway Island Access | 2004 | SHSTUR | ANDREW     | F | 5  | 0.038 | 0.422 |
| MDC      | 226/99.6  | 226  | Missouri R. @ Nodaway Island Access | 2004 | SHSTUR | ANDREW     | E | 1  | 0.14  | 0.867 |
| MDC      | 226/99.6  | 226  | Missouri R. @ Nodaway Island Access | 2004 | SHSTUR | ANDREW     | E | 1  | 0.103 | 0.726 |
| MDC      | 1604/47.5 | 1604 | Missouri R. @ Weldon Spring CA      | 2004 | SHSTUR | ST CHARLES |   | 5  | 0.036 | 0.184 |
| MDC      | 1604/47.5 | 1604 | Missouri R. @ Weldon Spring CA      | 2004 | SHSTUR | ST CHARLES | E | 1  | 0.114 | 0.57  |
| MDC      | 1604/47.5 | 1604 | Missouri R. @ Weldon Spring CA      | 2004 | SHSTUR | ST CHARLES | E | 1  | 0.07  | 1.1   |
| MDC      | 1604/47.5 | 1604 | Missouri R. @ Weldon Spring CA      | 2004 | SHSTUR | ST CHARLES | F | 5  | 0.058 | 0.431 |
| MDC      | 1604/47.5 | 1604 | Missouri R. @ Weldon Spring CA      | 2004 | SHSTUR | ST CHARLES | F | 5  | 0.058 | 0.739 |
| MDC      | 1604/47.5 | 1604 | Missouri R. @ Weldon Spring CA      | 2004 | SHSTUR | ST CHARLES | E | 1  | 0.113 | 0.766 |
| EPA/MDNR | 356/119.2 | 356  | Missouri R. bl. Blue R.             | 2005 | C CARP | JACKSON    |   | 5  |       | 0.58  |
| EPA/MDNR | 226/80.5  | 226  | Missouri R. @ St. Joseph, Mo.       | 2005 | C CARP | BUCHANAN   | W | 5  |       | 0.049 |

Note: Site = WBID/number of miles from mouth; u = urban; r = rural; # in sample = the number of fish in each "sample".

Type = what form of the fish is evaluated:

W = the whole fish

F = the fillet of the fish only

E = the fish eggs only

